An Apparent Induction of Secondary Dormancy in *Eucalyptus globulus* Labill Seeds

by

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Declaration

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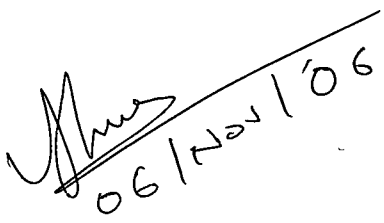

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Abbreviation and Symbols

ABA	Abscisic acid
ACC	1-aminocyclopropane-1-carboxylic acid
ANOVA	Analysis of variance
ATP	Adenine tri phosphate
^{o}C	degrees Celsius
$Ca(NO_3)_2$	Calcium nitrate
cm^3	Cubic Centimetre
CO_2	Carbon dioxide
cm	Centimetre
DNA	Deoxyribonucleic acid
ETH	Ethanol
FR	Far red light
GA_3	Gibberellic acid
g	Gram
h	Hours
ha	Hectare
IAA	Indole Acetic Acid
ISTA	International Seed Testing Association
KCl	Potassium Chloride
KIN	Kinetin
KNO_3	Potassium nitrate
KOH	Potassium hydroxide
K_3PO_4	Potassium phosphate
LSD	Least Significant Difference
m	Metre
mL	Milli Litre
mm	Milli Metre
mM	Milli Molar
MPa	Megapascal
mRNA	Messenger Ribonucleic acid

MSP	Mass Supplementary Pollination
$NaNO_3$	Sodium nitrate
nm	Nano Metre
ODS	oleoyl phosphatidal choline desaturase
OSP	One Stop Pollination
P	Probability
PEG	Polyethylene glycol
Pfr	Far red absorbing (active) phytochrome
P/L	Private Limited
R	Red light
RNA	Ribonucleic acid
RWC	Relative water content
S	South
SEM	Standard Error of the Mean
SPSS	Statistical Package for the Social Science
STBA	Southern Tree Breeding Association Inc.
STDEV	Standard deviation
%	Percentage
®	Registered
µM	Micro Molar
µm	Micro Metre

Species Name

Common Names	Scientific Names
Allepo pine	*Pinus halepensis*
Alpine ash	*Eucalyptus delegatensis*
Alpine snowgum	*Eucalyptus nimphophila*
Ana tree	*Faidherbia albida*
Annual ragweed	*Ambrosia artemisiifolia*
Apple	*Malus domestica*
Areca palm	*Dypsis lutescens*
Barley	*Hordeum* spp.
Beard-heath	*Leucopogon* spp.
Black box	*Eucalyptus largiflorens*
Blackbutts	*Eucalyptus pilularis*
Black ironbark	*Eucalyptus sideroxylon*
Black nightshade	*Solanum physalifolium*
Blue-white clover	*Trigonella coerulea*
Brindall berry/ Malabar Tamarind	*Garcinia gummi-gutta*
Broadleaf dock	*Rumex obtusifolius*
Broad leaf ironbark	*Eucalyptus fibrosa*
Broad-leaved peppermint	*Eucalyptus dives*
Brown barrel/ Cut tail	*Eucalyptus fastigata*
Bull mallee	*Eucalyptus behriana*
Bull thistle	*Cirsium vulgare* (Savi) Ten.}
Burning bush	*Dictamnus* spp.
Cabbage gum	*Eucalyptus pauciflora*
Calabrian pine	*Pinus brutia*
Capeweed	*Arctotheca calendula*
Celery	*Apium graveolens*
Charlock mustard	*Sinapsis arvensis*
Cloeziana gum	*Eucalyptus cloeziana*

Cocklebur	*Xanthium strumarium*
Coolibah tree	*Eucalyptus microtheca*
Common elderberry	*Sambucus canadensis*
Common oat	*Avena sativa*
Common peppermint	*Eucalyptus radiata*
Corn/Shirley poppy	*Papaver rhoeas*
Cucumber	*Cucumis sativus*
Empress tree	*Paulownia tomentosa*
European beech	*Fagus sylvatica*
Evergreen clematis	*Clematis vitalba*
Forest redgum	*Eucalyptus tereticornis*
Giant-flowered phacelia	*Phacelia grandiflora*
Gippsland blue gum	*Eucalyptus globulus* subsp. *pseudoglobulus*
Good king Henry	*Chenopodium bonus-henricus*
Grevillea/ silky oak	*Grevillea robusta*
Grex box	*Eucalyptus moluccana*
Guinea flower	*Hibbertia amplexicaulis*
Gum cistus	*Cistus ladanifer*
Hedge mustard	*Sisymbrium officinale*
Iceberg/prickly lettuce	*Lactuca sativa*
Indonesian gum	*Eucalyptus deglupta*
Ivory lace	*Thryptomene calycina*
Jarrah/ Swan river mahogany	*Eucalyptus marginata*
Jointed rush	*Juncus articularis*
Knotweed	*Polygonum* species
Kybean mallee ash	*Eucalyptus kybeanensis*
Lacy scorpion weed	*Phacelia tanacetifolia*
Maize	*Zea mays*
Maritime pine	*Pinus pinaster*
Meadowfoam	*Limnanthes alba*
Mongolian Psammichloa	*Psammochloa villosa*

Mottlecah	*Eucalyptus macrocarpa*
Mountain ash	*Eucalyptus regnans*
Mount buffalo sallee/ gum	*Eucalyptus mitchelliana*
Mt. Wellington peppermint	*Eucalyptus coccifera*
Narrowleaf plantan	*Plantago lanceolata*
Northern bush honeysuckle	*Diervilla lonicera*
Norway maple	*Acer platanoides*
Oilseed rape	*Brassica napus*
Parodi Burkart	*Caesalpinia paraguariensis*
Peach	*Prunus persica*
Pennygrass	*Thlaspi arvense*
Pitcher plant	*Sarracenia* spp.
Poppy Anemone	*Anemone coronaria*
Proliferating bulrush	*Isolepis prolifera*
Purple coneflower/ Echinacea	*Echinacea purpurea*
Redroot pigweed	*Amaranthus retroflexus*
Red bloodwood	*Eucalyptus gummifera*
Red-capped gum	*Eucalyptus erythrocorys*
Red elderberry	*Sambucus pubens*
Red mallee	*Eucalyptus oleosa*
Red river gum	*Eucalyptus camaldulensis*
Red stringybark	*Eucalyptus macrorhyncha*
River peppermint	*Eucalyptus andreana*
Round leaf snow gum	*Eucalyptus perriniana*
Ryegrass	*Lolium perrene*
Salmon gum	*Eucalyptus salmonophloia*
Shining gum	*Eucalyptus nitens*
Silver maple	*Acer saccharinum*
Silver top ash	*Eucalyptus sieberi*
Small balsam	*Impatiens parviflora*
Sorghum	*Sorghum bicolor*
South American rush	*Juncus microcephalus*

Soybean	*Glycine max*
Spotted blue gum	*Eucalyptus globulus* subsp. *maidenii*
Spotted gum	*Eucalyptus maculata*
Spotted ladysthumb	*Polygonum persicaria*
Sticky hopbush	*Dodonaea viscosa*
Striped maple	*Acer pensylvanicum*
Sugar maple	*Acer saccharum*
Swamp gum	*Eucalyptus ovata*
Swamp yate	*Eucalyptus occidentalis*
Swift parrots	*Lathamus discolor*
Sycamore leafed maple	*Acer pseudoplatanus*
Tartarian maple	*Acer tartaricum*
Tasmania blue gum	*Eucalyptus globulus* subsp. *globulus*
Tassel flower	*Amaranthus caudatus*
Thalla-cress	*Arabidopsis* spp.
Tomato	*Lycopersicon esculentum*
Tropical red box	*Eucalyptus brachyandra*
Triggerplants	*Stylidium affine*
	Stylidium brunonianum
Victoria blue gum	*Eucalyptus globulus* subsp. *bicostata*
Wheat	*Triticum aestivum*
Whispering bells	*Emmenanthe penduliflora*
White gum	*Eucalyptus wandoo*
Wild lettuce	*Lactuca serriola*
Wild oat	*Avena fatua*
Winter fat	*Eurotia lanata*
Yellow box	*Eucalyptus melliodora*
Yellow buttercup	*Hibbertia hypericoides*
Yellow horn poppy	*Glaucium flavum*
York gum	*Eucalyptus loxophleba*

ABSTRACT

Eucalyptus globulus is a major plantation forestry species in southern Australia. Commercial *E. globulus* seedlots have high viability (95%) and uniform germination, which is completed within 5-6 days. However commercial nurseries have reported delays in germination with seedling emergence spread over five to ten weeks. According to growers and seed suppliers the problem is not restricted to particular seedlots and occurs in most nurseries. Observations have suggested that a brief period of desiccation or high temperature between sowing and germination may lead to the delays, but no clear cause has been established. Further, there is nothing in the literature to indicate either cause or possible management strategies. According to the ISTA guidelines the germination period of *E. globulus* is 5-14 days under laboratory conditions and in the field, germination should occur before 26 days. The aim of the present project was to establish the factors responsible for this apparent induction of previously unreported secondary dormancy in *E. globulus* seed and to provide a basis for commercial management of the problem.

Initial laboratory trials concentrated on grower reports that short term desiccation in the first few days after sowing might be responsible. A wetting/drying cycle was found to cause an extended germination period. Initial imbibition in darkness for periods of 18 - 36 h, followed by air drying in open storage for 7 days at 25°C reduced subsequent germination in 12 light/ 12 dark photoperiod and slowed germination rate. Subsequent experiments demonstrated that this effect was largely regulated by light.

As a result of the initial results, further investigations into light sensitivity in *E globulus* seeds were undertaken. Seeds initially imbibed in darkness for 18 - 36 h and then exposed to light showed decreased germination in darkness compared with seeds exposed throughout to continuous light, continuous dark or continuous light during imbibition followed by germination in darkness. These

results clearly indicate that initial exposure to darkness for 18 - 36 h followed by light caused a shift in germination behaviour.

Subsequent experiments on light quality showed that exposure to far red light throughout imbibition and germination substantially reduced germination percentage, whilst under some circumstances exposure to red light promoted germination. Such a model appears to explain the commercial problem, with the anomalous germination symptom induced by light conditions prevailing in the hour following sowing.

Results are discussed in terms of a possible physiological basis for the induction of an apparent light mediated secondary dormancy in this species. The practical implications for commercial nurseries are also considered, with particular emphasis on light management, rather than the initial ideas on water relations.